REMARKS

Reconsideration of the above-identified patent application in view of the amendments above and the remarks following is respectfully requested.

Claims 1-10 are in this case. Claims 1, 3, 5 and 8 have been rejected under § 112, second paragraph. Claims 1, 2, 4 and 6 have been rejected under § 103(a). Claims 7, 9 and 10 have been allowed. Claim 8 has been canceled. Independent claim 1 has been amended. New claims 11-18 have been added.

The claims before the Examiner are directed toward methods of enhancing gray-scale and color images. In the case of a gray-scale image, both a normalized light dynamic range compressed image and a normalized dark dynamic range compressed image are computed, and then a balanced dynamic range compressed image is computed from the two normalized images. In the case of a color image, a balanced dynamic range compressed norm of the image is obtained and divided by the original norm of the image. The resulting quotient is used to multiply each of the original colors.

Oath/Declaration

The Examiner has identified two defects in the Oath/Declaration. The first defect is that the filing date listed for US 60/199,116, April 26, 2000, is inconsistent with the filing date of April 24, 2000 listed in the records of the USPTO. The second defect is that the claim for domestic priority cites 35 USC § 120 instead of 35 USC § 119(e).

Attached please find a replacement Oath/Declaration in which these defects have been corrected.

Drawings

The Examiner has objected to the drawings because Figure 3 includes reference numeral **30** that is not described in the specification.

As described below, the specification now has been amended to include a description of reference numeral **30**.

Amendments to the Specification

All occurrences of "non-color" have been changed to "gray-scale". This is merely a change in terminology that introduces no new matter.

An inadvertent error in Equation 3 has been corrected. The first term on the right hand side should have been "1" instead of "*FS*". That "*FS*" is obviously an error can be appreciated by considering that $I_{neg}(i,j)$ should be dimensionless just like $I_{pos}(i,j)$. Indeed, the second term on the right hand side of Equation 3 is a ratio of two intensities and so is dimensionless.

The paragraph beginning on page 10 line 6 has been corrected to more accurately describe the nature of $I_{neg}(i,j)$. This merely clarifies what was already inherent in the description of $I_{neg}(i,j)$ and does not add new matter.

A reference to Digital Image Supplier **30** of Figure 3 has been added to the paragraph beginning on page 12 line 3. This amendment resolves the Examiner's objection to the drawings.

An inadvertent spelling error on page 12 line 18 ("suports" instead of "supports") has been corrected.

No new matter has been added.

§ 112, Second Paragraph Rejections

The Examiner has rejected claims 1-6 and 8 under § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Specifically, the Examiner has pointed out that claim 1 recites the unclear term "singled color images" and that claims 3, 5 and 8 are incomplete for omitting, respectively, Equations 2, 3 and 8.

Claim 8 has been canceled, thereby rendering moot the Examiner's rejection of this claim.

The Examiner correctly interpreted the term "singled color image" to refer to a gray-scale image. This was indeed Applicant's intention in drafting claim 1. The reference to gray-scale images as "singled color images" was an inadvertent oversight. Claim 1 now has been amended to recite this explicitly: the term "singled color images" in claim 1 has been changed to "gray-scale images". Similarly, as described above, all occurrences of "non-color" in the specification have been amended to "gray-scale".

Claims 3 and 5 now have been amended to recite Equations 2 and 3 (as now amended) explicitly. Support for the amendment of claim 3 is found in the specification in the paragraph beginning on page 7 line 20, which paragraph introduces Equation 2 and defines the terms used in that Equation. Support for the amendment of claim 5 is found in the specification in the paragraph beginning on page 7 line 20 and in the paragraph beginning on page 9 line 29. The paragraph beginning on page 9 line 29 introduces Equation 3 and defines the term "*FS*"; the other terms used in that Equation are defined in the paragraph beginning on page 7 line 20.

§ 103(a) Rejections – Rahman et al. '456 in view of Waxman et al. '244

The Examiner has rejected claims 1, 2 and 4 under § 103(a) as being unpatentable over Rahman et al., US Patent No. 5,991,456 (henceforth, "Rahman et al. '456") in view of Waxman et al., US Patent No. 5,909,244 (henceforth, "Waxman et al. '244). The Examiner's rejection is respectfully traversed.

Rahman et al. '456 teach a method of improving a digital image. The image is convolved with a "surround function" $F(x,y)$ analogous to the averaging kernel of the present invention. The logarithm of the results of the convolution is subtracted from the logarithm of the image. This operation is performed for several values of a parameter c that controls the effective width (in pixels) of $F(x,y)$. As noted in column 4 lines 42-44, values of c in the range of 1% to 20% of the total width of the image are used for dynamic range compression.

The Examiner has interpreted the outputs of the first two such operations, using surround functions $F_1(x,y)$ and $F_2(x,y)$, as corresponding to the computation of the light dynamic range compressed image and the dark dynamic range compressed image, respectively, of the present invention. In fact, neither operation is either a light dynamic range compressed image computation or a dark dynamic range compressed image computation. This can be best appreciated by considering that the surround functions $F_1(x,y)$ and $F_2(x,y)$ are local operators. So denoting the input image as I_i and the output image as I_o, the computation that Rahman et al. '456 do using a surround function F is $I_o=\log\{I_i/(F*I_i)\}=\log(I_i)-\log(F*I_i)$. Because F is a local operator, the average over the whole image of $\log(I_i)$ is equal to the average over the whole image of $\log(F*I_i)$. The average over the whole image of I_o then is exactly zero: the dynamic range compression of Rahman et al. '456 produces no change in overall

brightness, i.e., no emphasis of light pixels over dark pixels or of dark pixels over light pixels.

Now, Applicant does not presume to claim to have invented the light dynamic range compressed image of the present invention. The light dynamic range compressed image, in and of itself, is acknowledged as prior art on page 3 lines 26-30 of the specification. The innovative step of the present invention, as recited in claim 1, is the computation of both the light dynamic range compressed image and the dark dynamic range compressed image, as inputs to the computation of the final balanced dynamic range compressed image.

Waxman et al. '244 is cited by the Examiner only to show that the use of a compressed, normalized dynamic range is known in the prior art. The obvious combination of Rahman et al. '456 and Waxman et al. '244 would be the computation of two normalized dynamic range compressed images with no change in overall intensity, using averaging kernels of two different sizes (as in Rahman et al. '456), followed by the computation of a balanced dynamic range compressed image (as in Waxman et al. '244). There is neither a hint nor a suggestion in Rahman et al. '456 and Waxman et al. '244, taken separately or together, of the computation of a normalized light dynamic range compressed image, let alone a normalized dark dynamic range compressed image. Thus, independent claim 1 is allowable in its present form over the Rahman et al. '456 and Waxman et al. '244 references.

With independent claim 1 allowable in its present form, it follows that claims 2 and 4, that depend therefrom, also are allowable.

§ 103(a) Rejections – Rahman et al. '456 and Waxman et al. '244 and further in view of Matama '273

The Examiner has rejected claim 6 under § 103(a) as being unpatentable over Rahman et al., US Patent No. 5,991,456 and Waxman et al., US Patent No. 5,909,244 and further in view of Matama, US Patent No. 6,101,273. The Examiner's rejection is respectfully traversed.

It is demonstrated above that independent claim 1 is allowable in its present form. It follows that claim 6, that depends therefrom, also is allowable.

Objections

The Examiner has objected to claims 3 and 5 as being based on a rejected base claim. The Examiner has noted that claims 3 and 5 would be allowable if rewritten in independent form including all the limitations of the base claim and any intervening claim and also to overcome the rejections under § 112, second paragraph.

In view of the discussion above in the context of the § 103(a) rejections, Applicant submits that the base claim from which claims 3 and 5 depend are allowable, making claims 3 and 5, as now amended to overcome the § 112, second paragraph rejections, allowable.
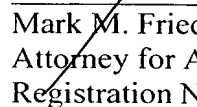
New Claims

New claims 11-18 have been added.

As noted above, the innovative step recited in claim 1 is the use of both a light dynamic range compressed image and a dark dynamic range compressed image. New independent claim 11 is essentially claim 1 without the limitation that the light and dark dynamic range compressed images must be normalized. New dependent claim 12 restores this limitation and so is essentially equivalent to claim 1.

The Examiner has acknowledged that the method of Equation 2 for computing a light dynamic range compressed image is patentable over the cited prior art. Therefore, new independent claim 13 recites the present invention through the computation of the light dynamic range compressed image according to Equation 2, as described in the specification on page 6 line 25 through page 8 line 6. New dependent claim 14 requires the light dynamic range compressed image to be computed using a lookup table for $\dfrac{1}{K+W*\{N\}}$, as described in the specification on page 12 lines 24-28. New dependent claim 15 requires the light dynamic range compressed image to be computed using a lookup table for $\dfrac{N}{K+W*\{N\}}$, as described in the specification on page 12 line 28 through page 13 line 4. New dependent claim 16 adds the computation of the dark dynamic range compressed image according to Equation 3 as now amended, as described in the specification on page 9 line 29 through page 10 line 10. New dependent claim 17 adds the normalizing and truncating of the light and dark dynamic range compressed images to produce normalized light and dark dynamic range compressed images. An enabling description of one way to do this is found in the specification on page 10 line 11 through page 11 line 8. New dependent claim 18 adds the combining of the normalized light and dark dynamic range compressed images to produce a balanced dynamic range compressed image. An enabling description of how to do this is found in the specification on page 11 lines 12-19.

In view of the above amendments and remarks it is respectfully submitted that independent claims 1, 7, 11 and 13 and hence dependent claims 2-6, 9, 10, 12 and 14-18 are in condition for allowance. Prompt notice of allowance is respectfully and earnestly solicited.

Respectfully submitted,

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